Communication Systems Group CSG, University of Zürich

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Aus den Instituten

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The Communication Systems Group CSG at the Department of Informatics (Institut für Informatik, IfI) of the University of Zurich UZH, Switzerland was founded in September 2004. Since 10 years Prof. Dr. Burkhard Stiller heads this research group in Zürich, thus, a perfect reason for this brief anniversary overview and review. The CSG's key mission is to establish excellent research in communications, addressing communication mechanisms for charging, accounting, mobility, and security, while considering Telecommunication economics, network and service management, and highly-decentralized systems as major pillars of today's and tomorrow's communications in the Internet. Secondly, the CSG is committed to provide a basic, but comprehensive and up-to-date teaching curriculum on networks and communications for Bachelor and Master students, partly in conjunction with other research groups at the IfI.

Collaborations

Research fields in communications are broad and manifold. Thus, the CSG focuses today on the area of network and service management, with a very special attention on the cross-disciplinary areas of technology, economics and regulation, all addressing telecommunications as of today and for the Future Internet. While past expertise in network management, overlay networks, and charging had been collected as a coordinator, amongst others, in the FP7 STREP SmoothIT, the FP7 CSA SESERV, the COST Action Econ@Tel, the Cisco-funded SCRIPT project, the NTT DoCoMo Eurolabs-funded DAMMO II project, and Swiss National Science Foundation projects DaSaHIT and CoopSC, and as project partner of the NoE EMANICS, the IP Daidalos II and Akogrimo, and the STREP EC-GIN besides AMAAIS (Swiss Bundesamt für Bildung und Technologie) and SciMantic (Swiss Commission for Technology and Innovation), current projects contribute to this know-how even further and cover as a coordinator the FP7 STREP SmartenIT and as a partner the FP7 NoE FLAMINGO and the COST Action ACROSS.

Research

While the application of network management mechanisms in the networking domain has progressed in terms of technical approaches very far, the integration of economic management mechanisms into existing network management models remains under strong developments. Thus, this CSG work investigates the use of, *e.g.*, pricing models and auctions, business models, on-line social networks, and a fully integrated, distributed accounting infrastructure for highly decentralized systems.

Telecommunications Economics follow the goal to investigate and model a suitable integrated networking architecture for multi-provider technical, socio-economic, and regulatory aspects of telecommunications. As such the CSG works on the provisioning of guidelines and recommendations to European players (end-users, enterprises, operators, regulators, policy makers, and content providers) for new converged management services to citizens and enterprises, especially to address the high decentralization aspect of multi-player situations and the regulatory constraints. SmartenIT work from the CSG covers amongst other on-line social network incentives and parameter exploitations for traffic management purposes and multi-resource allocation schemes for cloud services and systems.

And this decentralized aspect drives the work on overlay networks and systems, too. Still, the popularity of peer-to-peer (P2P) is highly visible, but security, digital rights management, NAT traversal and file synchronization, and market management aspects have been neglected for quite some time. Work in this area targets at suitable models and technology to enable NAT support for P2P services as well as electronic currencies and payment systems. In that respect the world's first mobile Bitcoin payment solution Coinblesk, which can run reliable Bitcoin transactions in less than a second via Near Field Communication (NFC)

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applying Google's Host Card Emulation (HCE) in devices running Android 4.4, had been designed, prototyped, and provided to local Mensa visitors in a three weeks trial successfully. Coinblesk serves as an important example of applied research, which embedded students at the same time.

The area of charging and Quality-of-Service (QoS)/ Quality-of-Experience (QoE) addresses the problem of providing necessary architectural and functional features in an Internet-based environment so that networking customers will be enabled to select services according to their needs and will be charged for those in a fair, incentive-driven manner. Pre-paid mechanisms for All-IP networks and services were under investigation and approaches to break the termination rates monopoly are under development. A close relation to the work undertaken in the area of distributed accounting can be observed and QoE model generalizations for Internet services have been performed, which resulted recently in the DQX model.

Finally, the Internet-of-Things (IoT) field, especially in terms of Wireless Sensor Networks and security is relevant for a broad range of IP-based interactions of devices. Since IoT is not limited to notebooks and servers anymore, but since IoT includes also constraint devices, *e.g.*, handhelds and sensor nodes, those devices are limited in memory, power, and computational capacity and still need to include security functionality. Thus, the work performed addresses the security-by-design principle in order to build trust into those networks and to support privacy.

Teamwork

The CSG operates its own test-bed for experiments, covering basically a few dozens of high-end servers, interconnected in a highly flexible topology (IPv6-enabled), and respective high-end compute power and data storage for simulations and results. Hosting the PLC for EMANICSLab, a European distributed research and evaluation platform, and providing access to PlanetLab complements the experimental facilities beyond the local domain.

Additionally, the CSG is active in standardization within the IETF (ACE working group) and the ITU-T, in which very recently the Y.3013 Recommendation on "Socio-economic Assessment of Future Networks by Tussle Analysis" has been released finally, holding major CSG contributions and being driven by the CSG's editor role.

Those areas of research, standardization, and teaching duties below are handled by the CSG team, which includes today two senior research scientists (Oberassistenten) Dr. T. Bocek, Dr. C. Schmitt, six junior researchers (Doktoranden) D. Dönni, R. Garg, A. Lareida, G. Machado, P. Poullie, and C. Tsiaras, and one international research fellow L. Kristiana, all backed by a comprehensive administrative support by M. Seric in the back office.

Teaching

The CSG offers to students in the undergraduate and graduate level teaching services fully embedded into the Department of Informatics curriculum. While basics on computer engineering and organization are part of the "Informatics I" assessment lecture in the first year, the introduction into "Computer Networks" in general follows at the start of year two for Bachelor students. "Informatics for Economics" is supported with an overview in secure systems, addressing in general organizational and technical security measures in computer science. For Bachelor as well as Master students in their major on Software Systems the course offer includes lectures on "Protocols for Multimedia Communications" addressing high-speed networking technology, Quality-of-Service, network management and multimedia protocols, and economic incentives, "Mobile Communication Systems" covering wireless local, public, and sensor network technology, and "Overlay Networks, Decentralized Systems, and Their Applications" featuring peer-to-peer systems, applications, distributed mechanisms, streaming, and distributed test-beds.

The practical aspects of communications are taught in the "Communication Systems Lab Course", comprising of TCP/IP, WLAN, DHCP and DNS, routing, security and firewalls, and Voice-over-IP. Two seminars on Internet Economics and Communication Systems for Bachelor and Master students, offered alternating in Spring and Fall terms, complete the course-based teaching curricula of the CSG. Of course, a variety of Master and Bachelor theses, Master and Student Projects, and Assignments are offered as individual study tasks, which leads to an average of 8–10 students per term to work jointly with the CSG team.

Further information on current projects, current news, and teaching can be accessed at the URL https://www.csg.uzh.ch.

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